Current Research Projects at USGS Woods Hole Science Center

Research Program Descriptions

- Marine Aggregates: Resources and Processes

Project start date: 1-OCT-1999 Project end date: 30-SEP-2006
Project Chief: Williams, S. Jeffress (jwilliams@usgs.gov)
Associate Project Chiefs:
Kindinger, Jack L. (jkindinger@usgs.gov)
Poppe, Lawrence J. (lpoppe@usgs.gov)

Coastal erosion and landloss are widespread on US shores, affecting 80-90 percent of coastal regions over the long term. Developed coasts and recreational beaches are particularly vulnerable. People are continuing to move to the coastal zone, and beaches are increasingly popular tourist destinations. With the prospects of future climate change causing increasing storminess and accelerating sea-level rise, coastal regions are likely to experience even greater erosion in future decades. Beach nourishment is increasingly used in many regions to mitigate coastal erosion, provide flood protection, and restore degraded coastal ecosystems. For a beach nourishment project to be successful, however, large volumes of high quality sand are necessary, ideally in close proximity to the project beach to reduce sand transport costs. Marine sand bodies on the inner to mid-shelf are attractive targets to be dredged for beach nourishment. However,the geologic character and distribution of sand bodies are often highly variable, depending on the sea-level rise history and marine processes that have affected shelf margins by multiple transgressions and regressions over the past 20,000 years. This project has developed and is implementing a scientifically rigorous series of regional studies, mapping seafloor sedimentary character and assessing marine sand and gravel resources around the United States. Results of regional assessments will ultimately comprise a national assessment of Coastal and Marine Geology resources and environment. The project is collaborating with the Minerals Management Service (MMS), the National Oceanic and Atmospheric Administration (NOAA), the US Army Corps of Engineers (USACE), and the University of New Orleans.

- Atlantic Coastal Groundwater Systems

Project start date: 01-OCT-1999 Project end date: 01-OCT-2008
Project Chief: Bratton, John F. (jbratton@usgs.gov)
Associate Project Chief: Crusius, John (jcrusius@usgs.gov)

Knowledge and understanding of groundwater movement and discharge along the Atlantic continental margin is needed to address issues of water supply, wastewater disposal, and ecosystem health. This project seeks to quantify the relative role of ground water in the water and nutrient budgets of several coastal areas. In particular, studies are determining natural flow paths and discharge rates to allow optimal human use of coastal aquifers, while minimizing negative impacts to coastal ecosystems, such as harmful algal blooms and the decline of seagrass beds and salt marshes. To improve accuracy of hydrologic models and management of coastal waters, information is needed to resolve how nutrients enter estuaries (diffuse vs. focused pathways). Current work is expanding previous efforts concentrated in coastal bays of the Delmarva Peninsula to new study sites in coastal North Carolina and in New England, including the Cape Cod National Seashore. Techniques include electrical resistivity surveys and geochemical analyses of surface water, pore water and ground water (including measurements of radon and radium isotopes). The multidisciplinary approach makes it possible to identify specific locations of groundwater discharge and to estimate discharge rates to incorporate into the water budgets and nutrient budgets of the new study sites. The project benefits from partnerships with the National Park Service , the Maryland Department of Natural Resources, the University of Toledo, the University of Rhode Island, the Woods Hole Oceanographic Institution, as well as USGS scientists of the Water Resources and Biological Resources disciplines.

- National Benthic Habitat Studies: Atlantic

Project start date: 01-OCT-2002 Project end date: 3-SEP-2007
Project Chief: Valentine, Page C. (pvalentine@usgs.gov)
Associate Project Chiefs:
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As coastal populations increase in size, the uses of the sea floor become more diverse and intensive. Knowledge of sea-floor characteristics and processes is required for successful management of many activities, including: (1) commercial and recreational fishing, (2) regulating sanctuaries and marine protected areas, (3) burial of fiber optic and electric power cables and oil and gas pipelines, (4) mining of sand, gravel and other minerals, (5) prospecting for biopharmaceutical compounds, (6) disposal of dredged materials from harbors, (7) ecotourism such as whale watching, (8) navigation and the transport of goods, and (9) military operations. In response to this pressure and the growing need to manage and protect fish stocks, seabed environments, and habitats, the goals of this project are (1) to determine the distribution of geological materials and processes that are the framework of habitats, (2) to map the location and character of benthic habitats, (3) to assess the impact of habitat disturbance by fishing gear, (4) to identify the processes and time periods required for the recovery of disturbed habitats, and (5) to establish a geology-based benthic habitat classification system. Habitat geology, as pursued by this project, addresses these needs by studying the distribution of geologic materials of the seabed, the geologic processes (e.g. sediment movement and deposition) that form the seabed, and the interplay of geologic factors and species behavior that gives rise to biological habitats in general and to specific habitats (Essential Fish Habitats) deemed essential to the success of managed fishery species. The project is collaborating closely with benthic ecologists and fisheries biologists from the Department of Interior (MMS, FWS, NPS), the Department of Commerce (NMFS, NOAA), state agencies, Canadian agencies (Geological Survey, Department of Fisheries and Oceans), and many universities.

- Portable Coastal Observatory Field Demonstration

Project start date: 15-SEP-2001 Project end date: 30-SEP-2004
Project Chief: Butman, Bradford (bbutman@usgs.gov)
Associate Project Chief: Martini, Marinna A.

Ocean observatories that provide data over a submarine cable are extremely expensive and provide data from a limited portion of the ocean. The 'portable' observing system in development complements cabled observatories by providing data from multiple instruments at modest data rates in a wide range of locations. The observing system consists of four elements: a low-cost acoustic data link that transfers data from instruments on the bottom or in the water column to a nearby surface buoy, a lightweight, easy to deploy surface buoy (and mooring), a radio-frequency modem to send data to shore, and a web-based automatic data distribution system. The system has been deployed and tested in Massachusetts Bay for extended periods. In FY2004, the project will focus on final testing and evaluation of the telemetry site at the Boston B Buoy where the acoustic receiver is mounted on an existing navigation buoy. Collaborating agencies and institutions include the Massachusetts Water Resources Authority and the Woods Hole Oceanographic Institution.

- Vulnerability of Coastal Park Resources

Project start date: 01-OCT-2001 Project end date: 30-SEP-2003
Project Chief: Williams, S. Jeffress (jwilliams@usgs.gov)
Associate Project Chief: Thieler, E. Robert (rthieler@usgs.gov)

The National Park Service (NPS) is responsible for managing nearly 12,000 km (7,500 miles) of shoreline along oceans and lakes. Because global sea level models predict a rise over present levels of 48 cm (18.9 in.) by 2100, more than double the rate of rise for the 20th century, the U.S. Geological Survey is conducting hazard assessments of future sea-level change on park shorelines, in partnership with the NPS Geologic Resources Division. Potential coastal impacts of sea-level rise include shoreline erosion, saltwater intrusion into groundwater aquifers, inundation of wetlands and estuaries, and threats to cultural and historic resources as well as infrastructure. Reports for 25 coastal park units are being produced using a coastal vulnerability index (CVI) that estimates a relative potential of coastal change due to future sea-level rise. The technique focuses on six variables that strongly influence coastal evolution: geomorphology, historical shoreline change rate, regional coastal slope, relative sea-level change, mean significant wave height, and mean tidal range. The CVI is one way that a park can assess objectively the natural factors that contribute to the evolution of the coastal zone, and thus how the park shoreline may evolve in the future.

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Investigate Geology of Connecticut

Project start date: 01-JUL-2001Project end date: 30-JUN-2004
Project Chief: Poppe, Lawrence J. (lpoppe@usgs.gov)

Because of its enormous surrounding population, Long Island Sound is stressed by anthropogenic wastes and contaminants that flow into the estuary. Understanding its benthic environmental problems requires detailed maps of the sediments and sedimentary environments. Our interpretations of regional sedimentary processes in Long Island Sound are based on reconnaissance (widely-spaced lines) and scattered continuous-coverage sidescan-sonar surveys. However, continuous-coverage sidescan sonar imagery is critical to (1) defining the geological variability of the sea floor, which is one of the primary controls of benthic habitat diversity; (2) improving our understanding of the processes that control the distribution and transport of bottom sediments and the distribution of benthic habitats and associated infaunal community structures; and (3) providing a detailed framework for future research, monitoring, and management activities. During this year, along with NOAA and the Connecticut DEP, we begin collaborative acquisition, processing, and interpretation of new multibeam bathymetric data from the eastern Sound. Existing samples and bottom photography will be used to verify geological interpretations based on the new digital bathymetric data.

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Marine Gas Hydrates

Project start date: 10/01/1999 Project end date: 09/30/2009
Project Chief: Hutchinson, Deborah R. (dhutchinson@usgs.gov)
Associate Project Chief: Collett, Timothy S., Denver, CO. (tcollett@usgs.gov)

Gas hydrate is a crystalline solid formed of water and gas. It looks and acts much like ice, but it contains huge amounts of methane and it exists in very large quantities in marine sediments in a layer several hundred meters thick directly below the sea floor and in association with permafrost in the Arctic. It is important for three reasons: 1. It may become a major energy resource; 2. It has important effects on sea floor sediment stability, influencing collapse and landsliding; 3. The hydrate reservoir may have strong influence on climate, as methane is a significant greenhouse gas. This project seeks to learn to identify gas hydrate by remote sensing and to understand the processes that control methane hydrate in the natural environment, such as concentration into possibly extractable accumulations, change in strength of sediments and generation of overpressures, processes of seafloor mobilization, and processes allowing transfer of methane to the atmosphere.

Current activities of this project are wide ranging. Physical testing of gas hydrate-bearing sediments is taking place in Woods Hole. Geochemical analysis of gases and quantities of gas in samples is underway in Menlo Park. Geophysical studies of natural hydrates in the Gulf of Mexico will require collection, special processing, and interpretation of field seismic data. Well-logging

studies will be carried out in Denver.

Cooperators and collaborators include the Department of Energy, Minerals Management Service (MMS), U.S. Navy, Lawrence Livermore National Laboratory (LLNL), Oak Ridge National Laboratory (ORNL), Geological Survey of Canada, Anadarko Petroleum, British Petroleum Ltd., Chevron Overseas Petroleum, Inc., Geoforschungs Zentrum, Japan Petroleum Exploration Company, Schlumberger HydroGeologica Services, Georgia Tech, Monterey Bay Aquarium Research Institute, Stanford University, University of Mississippi, Woods Hole Oceanographic Institution

- National Knowledge Bank - Coastal and Marine Geology

Project start date: 01-OCT-2000 Project end date: 30-SEP-2010
Project Chief: Hutchinson, Deborah R. (dhutchinson@usgs.gov)
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Wertz, Robert R. (rwertz@usgs.gov@usgs)

Following the recommendations of a National Academy of Sciences Review of the Coastal and Marine Geology Program (CMGP), the Coastal and Marine Knowledge Bank (CMKB) is being developed to ensure that coastal and marine geologic data, information, and knowledge are preserved and are made usefully accessible to a wide variety of public and governmental users. Goals are to share knowledge, to enable use of scientific results as the basis of decisions on such issues as resource management, land and sea use, marine habitats, waste disposal, and beach nourishment, and other issues from potential sources of aggregates, to energy. All three CMGP Centers will participate. Work this year will continue to refine the scope and approaches of the project, develop a prototype model, continue the digital capture and organization of the knowledge base (data and products) of the Coastal and Marine Geology Program, and assemble a suite of information infrastructure tools (both hardware and software technologies). Rapid technological advance and developments in knowledge management are necessitating a phased approach and an open, modular architecture. Collaboration is taking place with Dalhousie University, the Geological Survey of Canada, the Marine Biological Laboratory, National Oceanic and Atmospheric Administration (NOAA), the Island Institute, Rockland Maine, the University Center for Atmospheric Research (UCAR) DLESE Program Center, University of Colorado, the University of Maine, and the Woods Hole Oceanographic Institution.

- Law of the Sea - Outer Limits of the U.S. Continental Margins

Project start date: 01-OCT-2001 Project end date: 30-SEP-2007
Project Chief: Hutchinson, Deborah R. (dhutchinson@usgs.gov)
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The United Nations Convention on the Law of the Sea (UNCLOS) provides the authority by which coastal states (i.e., nations) may increase their claim to an extended continental shelf that exceeds the 200 nautical-mile (M) Exclusive Economic Zone guaranteed to every state. Once a state ratifies the treaty, it has 10 years in which to submit a claim for an extended continental shelf. Of the two common criteria by which a state can extend their continental shelf beyond 200 M, by bathymetry (the Hedberg formula) and by geology (the Gardiner, or sediment thickness, formula), the USGS has a key role to play in applying the geologic (Gardiner) formula to potential claims for the US and Trust Territory margins. The 'Law of the Sea - Outer Limits of the U.S. Continental Margins' project, in collaboration with other U.S. Federal agencies and academic institutions, will conduct geoscientific assessments of potential US claims to extend the seaward limits of the legal offshore continental shelf. The work will be done in accordance with guidelines established by the United Nations Commission on the Limits of the Continental Shelf.

Collaborating entities include the National Oceanic and Atmospheric Administration (NOAA), the Department of State, the Minerals Management Service (MMS), NOAA/University of New Hampshire Center for Coastal and Ocean Mapping/Joint Hydrographic Center, University of New Hampshire Center for Coastal and Ocean Mapping, the University of Florida, and the University of Texas Institute of Geophysics.

- The Massachusetts Bay Experiment

Project start date: 01-OCT-2002 Project end date: 30-SEP-2004
Project Chief: Bothner, Michael H. (mbothner@usgs.gov)
Associate Project Chief: Butman, Bradford (bbutman@usgs.gov)

The USGS has long worked cooperatively with the Massachusetts Water Resources Authority to contribute fundamental scientific information for management decisions on environmental and engineering issues in Boston Harbor and Massachusetts Bay. Following completion of the Boston Harbor sewage tunnel, in September, 2000, the nation's second largest sewage treatment plant stopped all discharges into Boston Harbor and began discharging its treated effluent at the new location in Massachusetts Bay, 9 miles seaward of the harbor mouth. The change in outfall location is allowing us to test predictions about the rates and ways wastes are transported in the coastal ocean, and to study the exchange between contaminants in sediments and the overlying water. In addition, we are continuing our collection of oceanographic observations (since 1989), and monitoring contaminant concentrations in sediments and suspended matter in western Massachusetts Bay in order to quantify long-term environmental change. The project is being conducted cooperatively with the Massachusetts Water Resources Authority (MWRA).

- Enhanced monitoring and rapid response planning for Ocean-bottom seismometers

Project start date: 1-OCT-2002 Project end date: 30-SEP-2003
Project Chief: Uri ten Brink (utenbrink@usgs.gov)

Many locations of earthquake and volcano activity are offshore, near shore, or on islands, where hazard assessment and monitoring require emplacing instrumentation on the sea floor. This presents significant technological challenges in accessibility to power and communications, ease of installation, effects of waves, currents, bottom-sediment conditions, and operational handling. The purpose of this project is to plan using technical expertise of the USGS Coastal and Marine Program in cooperation with the USGS Earthquake Hazards and Volcano Hazards programs to address improved Ocean Bottom Seismometers (OBS). The objective is to design and build an affordable real-time offshore seismic monitoring station (RTOSS), combining key aspects of mooring, radio telemetry, and ocean-bottom-seismometer technology into a low cost seafloor instrumentation package as an option for offshore real-time monitoring. Coordinating use of ocean-bottom seismometers among several USGS programs will facilitate monitoring and post-event studies in poorly covered regions.

- Sea and Lake Floor Mapping

Project start date: 01-OCT-1995 Project end date: 30-SEP-2005
Project Chief: Bradford Butman (bbutman@usgs.gov)
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Poppe, Lawrence J. (lpoppe@usgs.gov)
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Valentine, Page C. (pvalentine@usgs.gov)

Working in tandem with other projects, this project employs new high-resolution mapping systems

to create fundamental digital frameworks of geologic and environmental information about the sea floor, useful for a wide range of research and management issues. The instrument systems and techniques integrate sidescan sonar, multibeam sonar, high resolution seismic-reflection profiling, bottom imaging, direct sampling, and GIS (geographic information system) mapping-data management for interactive maps and special-purpose applications. Some of the areas recently mapped and newly characterized are the New York Bight, offshore of New York City, [http://woodshole.er.usgs.gov/project-pages/newyork/sfmaps_index.html]
the most heavily populated, and one of the most heavily used, coastal regions of the United States, the sea floor off Massachusetts,
[http://woodshole.er.usgs.gov/project-pages/coastal_mass/],
to serve increasing management needs ranging from waste management to effects of offshore wind-energy facilities; of Lake Mead NV,
[http://woodshole.er.usgs.gov/project-pages/LakeMead/index.htm]
on the Colorado River behind Boulder Dam, the first synthesis of the lake floor geology in its 65 year history.

Cooperators and collaborators with these efforts include: National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA), National Park Service (NPS), U.S. Army Corps of Engineers (USACE), Bureau of Reclamation (BOR), Connecticut Department of Environmental Protection, Lake Mead National Recreation Area, Massachusetts Coastal Zone Management, Massachusetts Water Resources Authority, Southern Nevada Water Authority Boston University, University of Massachusetts, University of Nevada, Las Vegas, University of Rhode Island, University of New Brunswick, University of New Hampshire, Rutgers University, Wesleyan University, and the Woods Hole Oceanographic Institution.

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National Community Sediment-Transport Modeling Project

Project start date: 01-OCT-2001 Project end date: 30-SEP-2010
Project Chief: Sherwood, Christopher R. (csherwood@usgs.gov)
Associate Project Chiefs:
Butman, Bradford (bbutman@usgs.gov)
Signell, Richard (rsignell@usgs.gov)
Warner, John (jcwarner@usgs.gov)

This project supports the development, testing, and application of numerical models for simulating oceanographic processes and movement of sediments, nutrients, and contaminants in the coastal ocean. The project also provides for development of support software for the models, and for field experiments to examine important processes represented by the models or to evaluate model performance. The models are community models, which means that they are being advanced, debugged, and applied by an informal, self-elected group of developers and users. In this case, the community includes scientists, engineers, and coastal resource managers from academic institutions, government agencies, and private industry, both in the U.S. and abroad. Community modeling systems exist for comparable earth-science disciplines, such as meteorology, climate change, groundwater, and physical oceanography, and these tools have proved invaluable in advancing science and decision making. We are working toward an ideal modeling system that implements peer-reviewed, process-based algorithms for circulation, sediment-transport, and biogeochemical processes related to pollution, eutrophication, coastal erosion, and turbidity. We are concentrating on public-domain models with sizeable user communities, like EcomSed, SWAN, POM, Coherens, and ROMS. We also use limited-distribution models (e.g., DELFT3D) that may eventually be brought into the public domain. We have adopted ROMS for use and evaluation in several regional applications and have added new turbulence and sediment-transport components to the code.

We cooperate and collaborate with entities including the NOAA's National Ocean Partnership Program and the National Ocean Service, US Navy Office of Naval Research, US Army Engineers Waterways Experiment Station, Delft Hydraulics Laboratory (The Netherlands), North Atlantic Treaty Organization SACLANT Undersea Research Center (Italy), Rutgers University, University of California Los Angeles, Virginia Institute of Marine Science, Woods Hole

Oceanographic Institution, state agencies, and private companies.

- Glacier Studies

Project start date: 01-OCT-2002 Project end date: 30-SEP-2008
Project Chief: Williams, Richard S. (rswilliams@usgs.gov)

The Glacier Studies Project is part of an international collaboration studying changes in the glacial component of the Earth's cryosphere. The cryosphere comprises glaciers, sea, lake, and river ice, snow cover, and permafrost, and is sensitive to changes in regional and global climate. Study of glaciers is important because their responses in area and volume to changes in regional and global climate can be measured and serve as critical indicators of climate changes. The equivalent of about 80 m of potential sea-level rise is currently held in glacier ice "stored" on land, and a rise in sea level is predicted due to warming of the global climate. To establish a baseline measure of global glacier area this project is producing atlases of glaciers, worldwide. The nearly complete 11-volume Satellite Image Atlas of Glaciers of the World uses Landsat images from 1972 to 1981. The 25-map series of Coastal-Change and Glaciological Maps of Antarctica is in production, using two sets of Landsat images (mid-1970's and late 1980's/early 1900's), September/October 1997 Radarsat images, the latest Landsat 7 ETM+ images, and other data where available, to define precisely grounded or floating glacier ice. A third study, of Glaciological Hazards, is using historic maps, aerial photographs, satellite images, other satellite data, and field-based observations to monitor and measure changes in glacierized areas that could lead to increased risk of a glaciological hazard [for example, glacier-outburst floods (jokulhlaups) caused by (1) the failure of ice-dammed lakes or (2) subglacial volcanic/geothermal activity, ice avalanches, surging glaciers]. Glacierized areas in Alaska, Himalaya, and the Andes of South America are of special interest.

International and domestic collaborating agencies, institutions, and scientists include the British Antarctic Survey, das Bundesamt fur Kartographie und Geodasie, Germany; Danmarks og Gronlands Geologiske Undersogelse; ENEA-AMB,Italy: Geological Survey of Canada; US National Park Service; Goddard Space Flight Center/NASA, Great Britain/International Glaciological Society; Instituto Antartico Argentino; Lanzhou Institute of Glaciology/People's Republic of China; National Energy Authority/Iceland; Norwegian Polar Research Institute; Alaska, International Permafrost Association; U.S. Geological Survey, Biology, Geography, Geology, Water-Resources Disciplines; University of Cambridge, U.K.; Volunteer for Science (46 yrs experience working with Alaskan/U.S. glaciers): Austin Post; Russian Academy of Sciences; Scott Polar Research Institute, Great Britain; University of Iceland; University of Nebraska; Vedurstofa Islands,Iceland.

- High-resolution geologic mapping offshore of Massachusetts

Project start date: 15-APR-2003 Project end date: 30-SEP-2006
Project Chief: Butman, Bradford (bbutman@usgs.gov)
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The goal of this project is to produce high-resolution maps of bathymetry, sonar imagery, and interpretations of sea floor geology offshore of Massachusetts. High-resolution mapping of the seafloor is essential for identifying and monitoring benthic habitats, determining the geological and biological processes active in coastal waters. and is integral to determining potential deposits of aggregates for construction or beach nourishment. North of Cape Ann, mapping will be carried out using a multibeam sea-floor mapping system in water greater than about 20 m. In the area of the South Essex Ocean Sanctuary (between Cape Ann and Boston), mapping will be carried out using sidescan sonar (with interferometric bathymetry) and chirp seismic reflection profiling in water depths less than about 30 m. In the Boston Harbor area, existing sidescan sonar and bathymetry collected by NOAA will be reprocessed as the basis for geologic maps of Boston Harbor and its approaches. The sea floor, particularly off the northeastern part of Massachusetts,

is complex and and heterogeneous, and will be studied in comparison with physigraphically similar glaciated marine areas elsewhere. These studies may identify seafloor features that are evidence of regional sea-level change and local historical events (e.g., 1755 earthquake, large storms). The results of the mapping in all three areas will be published as USGS digital maps and in Geographic Information System (GIS) formats. These investigations are being done in cooperation with the Massachusetts Office of Coastal Zone Management and the State of Massachusetts Executive Office of Environmental Affairs.

- North Carolina Regional Coastal Erosion Studies

Project start date: 10/01/2002 Project end date: 09/30/2005
Project Chief: Thieler, E. Robert (rthieler@usgs.gov)

This coastal research program is delineating the geologic framework of northeastern North Carolina fro False Cape, Virginia to Cape Lookout, North Carolina, and seeking to understand the physical processes driving the evolution of the coast. The study area includes Cape Hatteras and Cape Lookout National Seashores, the Wright Brothers National Monument, and the Pea Island and Cedar Island National Wildlife Refuges. The long-term program goal is to acquire comprehensive knowledge of this coastal system, including the estuaries, barrier islands, and inner continental shelf. This knowledge will be used to understand the linkage of geologic framework and physical processes to coastal evolution and possibly predict the coastal response to oceanographic and climatic forcing at time scales from storm events to centuries. Many of the research tasks are focused on, or can be used to identify and quantify, coastal hazards. Shoreline change (SWASH), [http://woodshole.er.usgs.gov/operations/swash/] monitoring provides information on the spatial and temporal response of the ocean shoreline to storm events, and provides insight into erosion hazard areas along the immediate shoreline. Nearshore geophysical surveys have linked erosion hotspots to specific surf zone morphologies that may recur over time due to interactions between physical processes and the shallow geologic framework. Ground-penetrating radar studies can identify pre-historic and historic inlet locations that may be reoccupied in future storms. Geomorphic mapping using historical air photos and recent LIDAR data shows the evolution of landform types, the impact of humans on the landscape, and resulting changes in coastal vulnerability to storms and long-term shoreline change. Geophysical surveys of the inner continental shelf provide an understanding of the geologic history of the coastal system, furnish insight into coastal sediment flux, and identify sand resources for mitigating erosion hazards through beach nourishment. Recognizing coastal hazards as a function of geologic setting and physical processes allows sound planning of hazard mitigation strategies. Agencies and institutions collaborating on this project include the North Carolina Geological Survey, East Carolina University, University of Delaware, and Virginia Institute of Marine Science.

- Northern South Carolina Coastal Erosion Studies

Project start date: 01-OCT-1999 Project end date: 26-SEP-2005
Project Chief: Schwab, William C. (bschwab@usgs.gov)
Associate Project Chiefs:
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Morton, Robert A. (rmorton@usgs.gov)
Warner, John C. (jcwarner@usgs.gov)

This project is studying the evolution of the coastal system of northern South Carolina: its coastal geologic framework, inner-shelf oceanographic and climatic processes, and their interactive responses, especially the factors and processes that control sediment movement in the coastal zone. Sediment budgets are difficult to quantify, and much of shoreline behavior on the Atlantic coast is influenced by antecedent geology. Therefore, a better conceptual understanding of coastal sediment dynamics can be attained by mapping the surface sediment distribution and subsurface stratigraphy of the lower shoreface, inner shelf, and the subaerial components of the system. Piecing these together with observed coastal evolution/behavior of the area advances capabilities of the coastal planning/engineering community to predict coastal change. To date,

areas of the inner shelf and lower shoreface have been mapped using high-resolution sidescan-sonar, subbottom profilers (CHIRP, Geopulse boomer), fathometer, interferometric sidescan/bathymetry, and sediment samples. In FY2004, site surveys for sediment-transport instrument deployments, additional vibracoring and sampling operations, and interpretation of marine geophysical data and shoreface maps are planned. Synthesis of the data gathered and evaluation of emerging process models will be pursued in subsequent years. This project is working in cooperation and collaboration with the U.S. Army Corps of Engineers (USACE), the Minerals Management Service (MMS), Coastal Carolina University, Scripps Institute of Oceanography, South Carolina Department of Natural Resources, South Carolina Sea Grant Consortium, the University of New Hampshire, and the College of Charleston.

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Caribbean tsunami and earthquake hazard studies

Project start date: 01-OCT-2002 Project end date: 26-SEP-2005
Project Chief: Uri ten Brink (utenbrink@usgs.gov)

In this century, the Virgin Islands, Puerto Rico and Hispaniola have been subjected to very large earthquakes followed by major aftershocks. Large tsunamis hit Puerto Rico and Hispaniola, killing as many as 1800 people in 1946 and 91 people in 1918. These catastrophies are caused by crustal movements along an active boundary between the North American plate and the northeast corner of the Caribbean plate. The present hazard-assessment map for Puerto Rico, the Virgin Islands, and Hispaniola is based on generalized assumptions about movement and coupling between big blocks and plates. Hazard models that are more precise require detailed mapping to identify the active fault systems and better estimates of their slip history and length. Recent multibeam bathymetric mapping of the Puerto Rico Trench in combination with syntheses of existing geophysical data, new analyses of earthquake data, and geodynamic modeling is resulting in better tectonic models for the present deformation of the area and greater understanding of the risks of earthquake and tsunami hazards. Cooperating or collaborating agencies and institutions include the National Oceanic and Atmospheric Administration (NOAA), the University of Puerto Rico, Mayaguez, Texas Tech University, the Universidad Complutense de Madrid, and the Woods Hole Oceanographic Institution.